

## REMARKS

Claims 1 – 21 are presently pending. In the above-identified Office Action, the Examiner rejected Claims 1 – 6, 8, 10 – 14, 16, 17, 20 and 21 under 35 U.S.C. § 102(b) as being anticipated by Applicants' Admitted Prior Art (AAPA). Claims 1 – 6, 8, 10 – 14, 16, 17, 20 and 21 were also rejected under 35 U.S.C. § 102(b) as being anticipated by a publication cited by Applicants entitled "A Stimulated Brillouin Scattering Phase-conjugate Mirror Having a Peak-Power Threshold" published by Jones *et al.* in 1995 (hereinafter "Jones"). Claims 1 – 6, 8, 10 – 14, 16, 17, 20 and 21 under 35 U.S.C. § 102(b) were also rejected under 35 U.S.C. § 102(b) as being anticipated by a publication cited by Applicants entitled "Measurements of SBS Reflectivity and Phase Conjugation Fidelity in Light Guides" by M. S. Mangir, published by Nonlinear Materials, Fundamentals and Application Conference in July, 1998. Claims 1 – 21 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Koch *et al.* (U.S. publication no.2005/0105867) hereinafter "Koch".

For the reasons set forth more fully below, the subject application is deemed to properly present claims patentable over the prior art. Reconsideration, allowance and passage to issue are respectfully requested.

As noted previously, the present invention addresses the need in the art for an efficient, robust, low threshold phase conjugate mirror for continuous wave or quasi-continuous wave applications with good polarization maintenance and good conjugation fidelity. The need in the art is addressed by the phase conjugate mirror of the present invention. In general, the inventive phase conjugate mirror includes a **photonic band gap** light guide and a stimulated Brillouin scattering medium disposed in operational relation thereto.

The invention is set forth in Claims of varying scope of which Claim 1 is illustrative. Claim 1 recites:

1. A phase conjugate mirror comprising:  
a **photonic band gap light guide** and  
a stimulated Brillouin scattering medium disposed in operational  
relation to said light guide. (Emphasis added.)

None of the references, taken alone or in combination, teach, disclose or suggest the invention as presently claimed. That is, none of the references, taken alone or in combination, teach, disclose or suggest a phase conjugate mirror with a **photonic band gap** light guide disposed in operational relation to a stimulated Brillouin scattering medium.

As mentioned above, in the Office Action, the Examiner cited AAPA, Jones, Mangir and Koch. However, none of these references taken alone or in combination, teach, disclose or suggest a phase conjugate mirror with a **photonic band gap** light guide disposed in operational relation to a stimulated Brillouin scattering medium as presently claimed. Fig. 1 of AAPA does not include a light guide.

Fig. 2 of AAPA typifies the apparent teachings of Jones and Mangir, i.e., that PCM reflectivity/threshold and phase conjugation fidelity can be improved for low power and/or highly aberrated beams by incorporating the SBS medium in a light guide geometry. However, neither Fig. 2 of AAPA, Jones nor Mangir include a **photonic band gap** (PBG) light guide as presently claimed.

In Fig. 2 of AAPA, the light guide is formed by a small internal diameter (< 0.5 mm) glass capillary 24', which is immersed in the liquid SBS medium 22'. The index of refraction of the capillary is less than that of the liquid allowing reflection off the inner walls of the capillary via total internal reflection for shallow grazing angles.

There are several limitations of the liquid light guide SBS PCM described in AAPA. First, it is not practical with gas media, as the lower index of refraction of the gas medium will not allow total internal reflection. Metal guides have been used with gas media in an attempt to circumvent this problem, but metal guides are lossy.

Second, the SBS threshold increases with higher angles of incidence entering the guide, thereby causing the SBS reflectivity to fall off with incidence angle. A condition for good phase conjugation fidelity is that all portions of the beam have essentially the

same reflectivity. This condition limits the acceptance angle of the guide for phase conjugation to a value well below that determined by geometrical optics (numerical aperture of the guide) restricting the étendue (area – solid angle product) of the incident beam.

Third, phase conjugation is a scalar process, and depolarization of the incident beam within the light guide represents a loss of phase information and attendant loss of phase conjugation fidelity. Depolarization is caused by phase shifts between the *s* and *p* waves reflected via total internal reflection within the guide. Depolarization increases with the length of the guide and is exacerbated by bending/coiling the guide to make the PCM more compact.

Finally, liquids are difficult to purify, and the residual impurities within the medium may absorb enough of the incident radiation to produce a liquid-to-vapor phase change (i.e., boiling of the liquid). Pressurizing the liquid has been used in liquid light guide SBS PCMs to increase the threshold for boiling, however this technique is limited by practical constraints on the applied pressure and adds cost and complexity to the PCM apparatus.

However, in accordance with the present teachings, a frustrated tunneling photonic band gap guidance or Bragg photonic band gap guidance scheme is used. In the Bragg PBG guidance regime, light can propagate in all layers (not evanescent).

The PBG guidance process does not require a core region with higher index than the cladding, allowing efficient propagation in a gas core fiber. This offers several advantages for high power fiber transmission, including high thresholds for breakdown and deleterious nonlinear processes such as stimulated Raman scattering. Low-index liquid cores may also be used, allowing for a larger SBS media selection with liquid light guide PCM devices. Additionally, the properties of the PBG fiber, such as dispersion, can be readily engineered by tailoring the geometry of the structure (hole spacing and fill factor). Additional advantages include (a) extremely low coupling between propagating modes, even with tight bends in the fiber; (b)

single mode operation with large core sizes; and (c) high polarization purity with just slight asymmetry in the structure.

The present invention builds on the advances in the field of photonic bandgap fibers. Rather than using the large core diameter afforded by the photonic bandgap structure to suppress nonlinear processes, the present invention encourages the nonlinear stimulated Brillouin scattering process by using a suitably small fiber core diameter and by exploiting the high numerical aperture and polarization preserving properties of the PBG guide to enhance nonlinear optical phase conjugation performance.

Although utilizing PBG fibers for the generation of multiple optical wavelengths by nonlinear processes, and more generally in enhanced nonlinear optics, has been suggested in the open literature references, practical schemes for using PBG structures in **guiding SBS PCM** devices have not been disclosed.

Koch merely endeavors to teach an active photonic-band gap optical fiber. However, Koch does not teach the use of a PBG structure in guiding SBS PCM devices. In any event, an Affidavit Under Rule 1.131 is enclosed which establishes a date of invention for the present invention which predates the effective date of Koch.

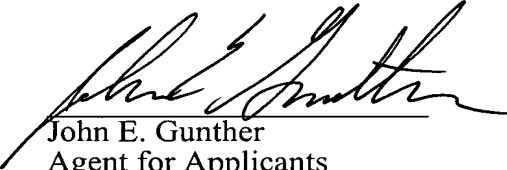
Accordingly, it should be evident that none of the references, taken alone or in combination, teach, disclose or suggest the invention as presently claimed. That is, none of the references, taken alone or in combination, teach, disclose or suggest a phase conjugate mirror with a **photonic band gap** light guide disposed in operational relation to a stimulated Brillouin scattering medium as presently claimed.

Reconsideration, allowance and passage to issue are respectfully requested.

Respectfully submitted,  
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